

**MONITORING ACTIVE VOLCANOES: STRATEGIES, PROCEDURES AND TECHNIQUES** edited by B. McGuire, C. R. J. Kilburn and J. Murray, UCL Press, London, 1995. No. of pages: 432. Price £65 HB. ISBN 1-85728-036-9.

So far, in this UN International Decade for Natural Disaster Reduction, some half a million people living on or near the slopes of reawakening volcanoes have been evacuated to safety. Had this not been the case, the number of eruption-related deaths, close to 1000 since 1990, would unquestionably have been very much greater. Much of the success in managing recent volcanic crises can be ascribed to timely decisions made in the light of scientific interpretations of geophysical and chemical observations. Volcanic eruptions, by definition, entail the passage of molten rock towards the Earth's surface. All volcano-monitoring techniques essentially aim to detect and measure the effects of these subterranean movements which typically develop over periods of months prior to an eruption. Familiar patterns of activity provide the basis for making predictions of the timing and nature of eruptions. This book, compiled from contributions by 28 (mostly European) volcanologists, reviews not only the more conventional methodologies for surveillance of active volcanoes but also a number of lesser known experimental techniques.

It is generally accepted that recording of the small earthquakes associated with rising magma is currently the single most useful and practical surveillance technique. Here, Ferrucci provides details of seismic source mechanics, procedures for locating events, and data interpretation. Another reliable indicator of volcanic activity is deformation of the ground surface in response to swelling or deflation of magma reservoirs. Such effects can be observed by precise surveying. Murray *et al.* give an excellent review of the methods, data analysis and interpretation of trilateration, precise and trigonometric levelling, and 'dry-tilt' measurement. Nunnari and Puglisi discuss the application of Global Positioning System survey networks, with reference to a case study of Mount Etna, while Toutain *et al.* draw on experience from Piton de la Fournaise volcano in reviewing electronic tiltmeter measurement and data processing. In addition to displacing the ground surface, magma flow causes

minor fluctuations in the gravity field. These can be detected by sensitive instrumentation, as explained here by Rymer.

The various dissolved volatiles in magma (water vapour, carbon dioxide, sulphur dioxide, etc.) form bubbles at different depths beneath a volcano on account of their varying solubilities. Thus the gases escaping from fumarole vents, and seeping through volcanic soils, are seen as messengers carrying information about subsurface activity. Tedesco reviews the deciphering of volcanic fluid chemistry, drawing on some of his own extensive work at several locations in Italy, while Andres and Rose focus on remote sensing methods for estimating gas compositions. Staying with remote sensing, Rothery *et al.* give an account of satellite infrared observations of heat radiated from volcanoes, including thermometry of flowing lava. Forecasting the advance of lava flows is the subject of a chapter by Kilburn *et al.*

Several electromagnetic methods have been applied to experimental studies of volcano interiors. These aim to detect variations in the surface magnetic field and in the electrical resistivity of rock layers within volcanoes, which result from thermal, chemical and pressure changes related to magmatic processes. Lénat and Zlotnicki review the theory and survey strategy of direct-current resistivity, self-potential, and magnetic measurements of active volcanoes.

Many of the aforementioned instrumental measurements can be made automatically once sensors have been installed. Lesage *et al.* contribute an important account of automated data acquisition, and data telemetry to distant observatories. The book is rounded off with a valuable contribution from Tilling, in which he relates some of the lessons learnt from recent volcanic crises and disasters, and introductory and concluding chapters by McGuire. The text is fully indexed, well-referenced and amply illustrated, and despite the European bias in authorship, the case studies cover volcanic activity in many parts of the world. This is certainly the most comprehensive, up-to-date and readily available book covering the subject.

CLIVE OPPENHEIMER  
*Department of Geography*  
*Cambridge University*